

## CHAPTER 4 (Odd)

1.  $V = IR = (2.5 \text{ A})(6 \Omega) = 15 \text{ V}$
3.  $R = \frac{V}{I} = \frac{6 \text{ V}}{1.5 \text{ mA}} = 4 \text{ k}\Omega$
5.  $V = IR = (3.6 \mu\text{A})(0.02 \text{ M}\Omega) = 0.072 \text{ V} = 72 \text{ mV}$
7.  $R = \frac{V}{I} = \frac{120 \text{ V}}{2.2 \text{ A}} = 54.55 \Omega$
9.  $R = \frac{V}{I} = \frac{120 \text{ V}}{4.2 \text{ A}} = 28.571 \Omega$
11.  $R = \frac{V}{I} = \frac{24 \text{ mV}}{20 \mu\text{A}} = 1.2 \text{ k}\Omega$
13. a.  $R = \frac{V}{I} = \frac{120 \text{ V}}{9.5 \text{ A}} = 12.632 \Omega$       b.  $t = 1 \text{ h} \left[ \frac{60 \text{ min}}{1 \text{ h}} \right] \left[ \frac{60 \text{ s}}{1 \text{ min}} \right] = 3600 \text{ s}$   

$$W = Pt = VIt$$

$$= (120 \text{ V})(9.5 \text{ A})(3600 \text{ s})$$

$$= 4.1 \times 10^6 \text{ J}$$
17.  $R = \frac{\Delta V}{\Delta I} \Rightarrow \Delta V = R(\Delta I) = (2 \times 10^3)(400 \times 10^{-3}) = 800 \text{ V}$
19.  $P = \frac{W}{t} = \frac{420 \text{ J}}{7 \text{ min} \left[ \frac{60 \text{ s}}{1 \text{ min}} \right]} = \frac{420 \text{ J}}{420 \text{ s}} = 1 \text{ W}$
21. a.  $8 \text{ h} \left[ \frac{60 \text{ min}}{1 \text{ h}} \right] \left[ \frac{60 \text{ s}}{1 \text{ min}} \right] = 28,800 \text{ s}$   
 $W = Pt = (2 \text{ W})(28,800 \text{ s}) = 57.6 \text{ kJ}$
- b.  $\text{kWh} = \frac{(2 \text{ W})(8 \text{ h})}{1000} = 16 \times 10^{-3} \text{ kWh}$
23.  $P = VI = (3 \text{ V})(2 \text{ A}) = 6 \text{ W}$   
 $t = \frac{W}{P} = \frac{12 \text{ J}}{6 \text{ W}} = 2 \text{ s}$
25.  $P = I^2 R = (7 \times 10^{-3} \text{ A})^2 (4 \Omega) = 196 \mu\text{W}$
27.  $I = \sqrt{\frac{P}{R}} = \sqrt{\frac{64 \text{ W}}{4 \Omega}} = \sqrt{16} = 4 \text{ A}$

29.  $V = \sqrt{PR} = \sqrt{(42 \text{ mW})(2.2 \text{ k}\Omega)} = \sqrt{92.40} = 9.61 \text{ V}$
31.  $P = VI, I = \frac{P}{V} = \frac{100 \text{ W}}{120 \text{ V}} = 0.833 \text{ A}$   
 $R = \frac{V}{I} = \frac{120 \text{ V}}{0.833 \text{ A}} = 144.06 \Omega$
33. a.  $P = EI$  and  $I = \frac{P}{E} = \frac{0.4 \times 10^{-3} \text{ W}}{3 \text{ V}} = 0.133 \text{ mA}$   
b. Ah rating =  $(0.133 \text{ mA})(500 \text{ h}) = 66.5 \text{ mAh}$
35. c.  $I = \sqrt{\frac{P}{R}} = \sqrt{\frac{500 \text{ mW}}{100 \Omega}} = \sqrt{5 \times 10^{-3}} \cong 70.7 \text{ mA}$
37. a.  $P = EI = (120 \text{ V})(100 \text{ A}) = 12 \text{ kW}$   
b.  $P_T = 5 \text{ hp} \left[ \frac{746 \text{ W}}{\text{hp}} \right] + 3000 \text{ W} + 2400 \text{ W} + 1000 \text{ W}$   
 $= 10,130 < 12,000 \text{ W (Yes)}$
39.  $\eta = \frac{P_o}{P_i}, P_i = \frac{P_o}{\eta} = \frac{(1.8 \text{ hp})(746 \text{ W/hp})}{0.685} = 1960.29 \text{ W}$   
 $P_i = EI, I = \frac{P_i}{E} = \frac{1960.29 \text{ W}}{120 \text{ V}} = 16.34 \text{ A}$
41. a.  $P_i = EI = (120 \text{ V})(2.4 \text{ A}) = 288 \text{ W}$   
 $P_i = P_o + P_{\text{lost}}, P_{\text{lost}} = P_i - P_o = 288 \text{ W} - 50 \text{ W} = 238 \text{ W}$   
b.  $\eta\% = \frac{P_o}{P_i} \times 100\% = \frac{50 \text{ W}}{288 \text{ W}} \times 100\% = 17.36\%$
43. a.  $P_i = \frac{P_o}{\eta} = \frac{(2 \text{ hp})(746 \text{ W/hp})}{0.9} = 1657.78 \text{ W}$   
b.  $P_i = EI = 1657.78 \text{ W}$   
 $(110 \text{ V})I = 1657.78 \text{ W}$   
 $I = \frac{1657.78 \text{ W}}{110 \text{ V}} = 15.07 \text{ A}$   
c.  $P_i = \frac{P_o}{\eta} = \frac{(2 \text{ hp})(746 \text{ W/hp})}{0.7} = 2131.43 \text{ W}$   
 $P_i = EI = 2131.43 \text{ W}$   
 $(110 \text{ V})I = 2131.43 \text{ W}$   
 $I = \frac{2131.43 \text{ W}}{110 \text{ V}} = 19.38 \text{ A}$
45.  $\eta_T = \eta_1 \cdot \eta_2 = (0.87)(0.75) = 0.6525 \Rightarrow 65.25\%$

47.  $\eta_T = \eta_1 \cdot \eta_2 = 0.72 = 0.9\eta_2$   
 $\eta_2 = \frac{0.72}{0.9} = 0.8 \Rightarrow 80\%$
49. a.  $\eta_T = \eta_1 \cdot \eta_2 \cdot \eta_3 = (0.98)(0.87)(0.21) = 0.1790 \Rightarrow 17.9\%$   
b.  $\eta_T = \eta_1 \cdot \eta_2 \cdot \eta_3 = (0.98)(0.87)(0.90) = 0.7673 \Rightarrow 76.73\%$   
 $\frac{76.73\% - 17.9\%}{17.9\%} \times 100\% \Rightarrow 328.66\%$
51. a.  $W = Pt = \left[ \frac{V^2}{R} \right] t = \left[ \frac{(15 \text{ V})^2}{10 \Omega} \right] 60 \text{ s} = 1350 \text{ J}$   
b. Energy doubles, power the same
53.  $\text{kWh} = \frac{Pt}{1000} \Rightarrow t = \frac{(1000)(\text{kWh})}{P} = \frac{(1000)(10 \text{ kWh})}{1500 \text{ W}} = 6.67 \text{ h}$
55. a.  $\text{kWh} = \frac{Pt}{1000} \Rightarrow P = \frac{(1000)(\text{kWh})}{t} = \frac{(1000)(500 \text{ kWh})}{10 \text{ s}} = 50 \text{ kW}$   
b.  $I = \frac{P}{E} = \frac{50 \times 10^3 \text{ W}}{208 \text{ V}} = 240.38 \text{ A}$   
c.  $P_{\text{lost}} = P_i - P_o = P_i - \eta P_i = P_i(1 - \eta) = 50 \text{ kW}(1 - 0.82) = 9 \text{ kW}$   
 $\text{kWh}_{\text{lost}} = \frac{Pt}{1000} = \frac{(9 \text{ kW})(10 \text{ h})}{1000} = 90 \text{ kWh}$
57.  $\text{kWh} = \frac{(860 \text{ W})(24 \text{ h}) + (4800 \text{ W})(1/2 \text{ h}) + (400 \text{ W})(1 \text{ h}) + (1200 \text{ W})(0.75 \text{ h})}{1000}$   
 $= 24.34 \text{ kWh}$   
 $24.34 \text{ kWh} [9\text{c/kWh}] = \$2.19$

## CHAPTER 4 (Even)

$$2. \quad I = \frac{V}{R} = \frac{12 \text{ V}}{72 \text{ } \Omega} = 166.67 \text{ mA}$$

$$4. \quad I = \frac{V}{R} = \frac{12 \text{ V}}{0.056 \text{ } \Omega} = 214.29 \text{ A}$$

$$6. \quad I = \frac{V}{R} = \frac{62 \text{ V}}{15 \text{ k}\Omega} = 4.133 \text{ mA}$$

$$8. \quad I = \frac{V}{R} = \frac{120 \text{ V}}{7.5 \text{ k}\Omega} = 16 \text{ mA}$$

$$10. \quad R = \frac{V}{I} = \frac{120 \text{ V}}{0.76 \text{ A}} = 157.89 \text{ } \Omega$$

$$12. \quad V = IR = (15 \text{ A})(0.5 \text{ } \Omega) = 7.5 \text{ V}$$

$$20. \quad t = \frac{W}{P} = \frac{640 \text{ J}}{40 \text{ W}} = 16 \text{ s}$$

$$22. \quad I = \frac{Q}{t} = \frac{300 \text{ C}}{1 \text{ min}} \left[ \frac{1 \text{ min}}{60 \text{ s}} \right] = 5 \text{ C/s} = 5 \text{ A}$$

$$P = I^2 R = (5 \text{ A})^2 10 \text{ } \Omega = 250 \text{ W}$$

$$24. \quad I = \frac{48 \text{ C}}{1 \text{ min}} \left[ \frac{1 \text{ min}}{60 \text{ s}} \right] = 0.8 \text{ A}$$

$$P = EI = (6 \text{ V})(0.8 \text{ A}) = 4.8 \text{ W}$$

$$26. \quad P = \frac{V^2}{R} = \frac{(9 \times 10^{-3} \text{ V})^2}{3 \text{ } \Omega} = 27 \text{ } \mu\text{W}$$

$$28. \quad I = \sqrt{\frac{P}{R}} = \sqrt{\frac{0.5 \text{ W}}{1 \text{ k}\Omega}} = 22.36 \text{ mA}$$

$$30. \quad P = EI = (9 \text{ V})(45 \text{ mA}) = 405 \text{ mW}$$

$$32. \quad V = \frac{P}{I} = \frac{450 \text{ W}}{3.75 \text{ A}} = 120 \text{ V}$$

$$R = \frac{V}{I} = \frac{120 \text{ V}}{3.75 \text{ A}} = 32 \text{ } \Omega$$

$$34. \quad I = \sqrt{\frac{P}{R}} = \sqrt{\frac{100 \text{ W}}{20 \text{ k}\Omega}} = \sqrt{5 \times 10^{-3}} = 70.71 \text{ mA}$$

$$V = \sqrt{PR} = \sqrt{(100 \text{ W})(20 \text{ k}\Omega)} = 1.414 \text{ kV}$$

36. a.  $P = EI = (9 \text{ V})(0.455 \text{ A}) = 4.095 \text{ W}$       b.  $R = \frac{E}{I} = \frac{9 \text{ V}}{0.455 \text{ A}} = 19.78 \Omega$
- c.  $W = Pt = (4.095 \text{ W})(21,600 \text{ s}) = 88.45 \text{ kJ}$   
 $6 \cancel{\text{h}} \left[ \frac{60 \cancel{\text{min}}}{1 \cancel{\text{h}}} \right] \left[ \frac{60 \text{ s}}{1 \cancel{\text{min}}} \right] = 21,600 \text{ s}$
38.  $\eta = \frac{P_o}{P_i} \times 100\% = \frac{(0.5 \cancel{\text{hp}}) \left[ \frac{746 \text{ W}}{\cancel{\text{hp}}} \right]}{450 \text{ W}} \times 100\% = \frac{373}{450} \times 100\% = 82.89\%$
40.  $\eta = \frac{P_o}{P_i} \times 100\% = \frac{746 \text{ W}}{(4 \text{ A})(220 \text{ V})} \times 100\% = \frac{746}{880} \times 100\% = 84.77\%$
42.  $P_i = EI = \frac{P_o}{\eta} \Rightarrow I = \frac{P_o}{\eta E} = \frac{(3.6 \cancel{\text{hp}})(746 \text{ W}/\cancel{\text{hp}})}{(0.87)(220 \text{ V})} = 14.03 \text{ A}$
44.  $P_i = \frac{P_o}{\eta} = \frac{(15 \cancel{\text{hp}})(746 \text{ W}/\cancel{\text{hp}})}{0.9} = 12,433.33 \text{ W}$   
 $I = \frac{P_i}{E} = \frac{12,433.33 \text{ W}}{220 \text{ V}} = 56.52 \text{ A}$
46.  $\eta_1 = \eta_2 = 0.8$   
 $\eta_T = (\eta_1)(\eta_2) = (0.8)(0.8) = 0.64$   
 $\eta_T = \frac{W_o}{W_i} \Rightarrow W_o = \eta_T W_i = (0.64)(60 \text{ J}) = 38.4 \text{ J}$
48.  $\eta_T = \frac{P_o}{P_i} = \eta_1 \cdot \eta_2 = \eta_1 \cdot 2\eta_1 = 2\eta_1^2$   
 $\eta_1^2 = \frac{P_o}{2P_i} \Rightarrow \eta_1 = \sqrt{\frac{P_o}{2P_i}} = \sqrt{\frac{128 \text{ W}}{2(400 \text{ W})}} = 0.4$   
 $\eta_2 = 2\eta_1 = 2(0.4) = 0.8$   
 $\therefore \eta_1 = 40\%, \eta_2 = 80\%$
50. a.  $1 \text{ watt} \cdot \cancel{\text{hour}} \left[ \frac{60 \cancel{\text{min}}}{1 \cancel{\text{h}}} \right] \left[ \frac{60 \cancel{\text{s}}}{1 \cancel{\text{min}}} \right] \left[ \frac{1 \text{ J}}{1 \text{ watt} \cdot \cancel{\text{sec}}} \right] = 3600 \text{ J}$   
 $1 \cancel{\text{kWh}} \left[ \frac{1000 \cancel{\text{Wh}}}{1 \cancel{\text{kWh}}} \right] \left[ \frac{3600 \text{ J}}{1 \cancel{\text{Wh}}} \right] = 3.6 \times 10^6 \text{ J}$
- b. For large energy applications the numbers would be enormous if joules were employed. For low levels of energy consumption the use of joules can be appropriate.

$$52. \quad \frac{12 \text{ h}}{\text{week}} \left[ \frac{4\frac{1}{3} \text{ weeks}}{1 \text{ month}} \right] [5 \text{ months}] = 260 \text{ h}$$

$$\text{kWh} = \frac{(230 \text{ W})(260 \text{ h})}{1000} = 59.80 \text{ kWh}$$

$$54. \quad \text{kWh} = \frac{(30 \text{ W})(3 \text{ h})}{1000} = 0.09 \text{ kWh}$$

$$(0.09 \text{ kWh})(9\text{¢/kWh}) = 0.81\text{¢}$$

$$56. \quad \text{a.} \quad \# \text{kWh} = \frac{\$1.00}{9\text{¢}} = 11.11$$

$$\text{kWh} = \frac{Pt}{1000} \Rightarrow t = \frac{(\text{kWh})(1000)}{P} = \frac{(11.11)(1000)}{250} = 44.44 \text{ h}$$

$$\text{b.} \quad t = \frac{(\text{kWh})(1000)}{P} = \frac{(11.11)(1000)}{4800} = 2.32 \text{ h}$$

$$58. \quad \text{kWh} = \frac{(110 \text{ W})(4 \text{ h}) + (1200 \text{ W})(1/3 \text{ h}) + (60 \text{ W})(1.5 \text{ h}) + (150 \text{ W})(3 \frac{3}{4} \text{ h})}{1000}$$

$$= \frac{440 \text{ Wh} + 400 \text{ Wh} + 90 \text{ Wh} + 562.5 \text{ Wh}}{1000} = 1.4925 \text{ kWh}$$

$$1.4925 \text{ kWh}[9\text{¢/kWh}] = 13.43\text{¢}$$